of consciousness in general, in the lower forms of animal life, that it may be well to remind ourselves of its analogy with the fact that the facial expressions produced by sweet and bitter tastes have been noted in an infant whose cerebral hemispheres were lacking. We do not regard the reflex production of these facial movements under abnormal conditions as incompatible with their being normally the expression of conscious process: why then should the squirming movements of the detached hinder end of a worm prove that such movements are not normally the accompaniment of pain sensation? The author uses as an *a priori* argument against the existence of pain sensations in animals of low structure the consideration that such sensations would be of no use to an animal like the earthworm, for the function of pain is to serve as a warning enabling an animal to avoid harmful stimuli in the future. "A mammal that has been hurt by a man will fear and so far as possible avoid man in the future, but an earthworm can neither recognize nor avoid man." This reasoning seems highly superficial, in view of the fact that recent work on the lower invertebrates has shown that reactions of anticipation, where one stimulus comes to serve as a "warning" of another, causing the avoiding reaction to be made before the second and injurious stimulus arrives, are found even in animals as low as the sea-anemone.

To the higher mammals, however, Ziegler would not deny the possession even of memory ideas, and it is amusing to find him quoting Ament's wholly uncritical observation on the dog that licked the ice off the window pane and looked out, as evidence that "ideas of ends" are present in the mind of a higher animal. Truly it is hard to be consistent in one's use of facts as evidence when one is guided by *a priori* considerations. The essential difference between the human mind and that of the other mammals Ziegler holds to be the possession of abstract ideas.

One of the later sections of the essay gives a brief account of the author's theory that acquired or "embiontic" pathways in the nervous system depend "on small and slow changes (of form and especially of thickness) in the ramifications of the cell processes, as well as on the formation of paths within the cell-body (formation or strengthening of neurofibrils)."

The appendix on the brain of ants and bees is explanatory of some plates from models by Ziegler's pupils.

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THE PROBLEM OF ELEMENTAL LIFE

Recent investigations on the part of certain physiologists and histologists tend to throw some new light upon perhaps the greatest of all scientific and philosophical questions, the problem of life and death. Whereas until recently the transition from the state of life to that of death was considered, at least by the medical and legal profession, to occur at the moment when the heart stopped beating, recent observations tend to show that besides this general conception of life and death, there exists also an entirely different form of life, an elemental life of the tissues, which under certain conditions may continue for long periods after the general life of the animal has ceased, after the heart has stopped beating and the personality of the individual has been lost. The elemental death begins, under normal conditions, promptly after general death has occurred and is caused by the two factors of bacterial invasion and ferment activity, the change manifesting itself by loss of cell tension and alterations in cell form, the first steps toward putrefaction and dissolution. If, however, immediately after general life has ceased to exist, fragments of tissue are removed from the body and placed in such a condition as to prevent bacterial or ferment action, the elemental life of the tissue may be maintained over long periods of time. Such a life is latent; it shows no signs of vital activity; upon such a piece of tissue being replaced in the animal body and its nutrition being maintained by a renewal of the circulation, life again becomes manifest, and the tissue renews its functional activity as a part of the living organism.

Such latent life may be of two types, potential life and unmanifested actual life. In the first condition metabolism is completely suspended as in the case of seeds kept at a very low temperature. Its application in animal life is not absolutely proved, and it is of greater theoretical than practical importance. Unmanifested actual life, however, was shown to be possible by Loevenhoeck in the case of *Milnesium tardigradum,* an animal organism which renewed its life after a long period of complete dryness. This form of latent life has been used extensively by Carrel in his work on transplantation of arteries and organs. It is the condition which normally exists immediately after general death and continues until bacterial and enzymotic action produces elemental death. Normally it lasts but a few hours at the most, but may by strict asepsis and a continued temperature between 0° C. and 1° C. be maintained for weeks or months. It is not a complete suppression of metabolism, but is metabolism reduced to an inappreciable minimum, to so low a grade that the changes produced are not sufficiently destructive to prevent the revitalization of the tissues.

Until recently, these two types of latent life were considered to be the only forms of life which could be maintained outside of the animal body, after general death had occurred. Stimulated, however, by the work of Harrison, who a few years ago grew nerve cells of embryo frogs in a drop of plasma, Carrel and Burrows, of the Rockefeller Institute for Medical Research, have recently carried out experiments in producing actual manifest life in adult mammalian tissue. Their brilliant results are reported in brief preliminary notes in *The Journal of the American Medical Association* for October 15 and 29, 1910. The principle of the experiments was extremely simple; the technique was rendered possible by the careful organization of the department of experimental surgery at the Rockefeller Institute. The experiments consisted in removing bits of tissue from mammals immediately after killing them, the most minute precaution being taken to procure asepsis, inoculating the tissue into a drop of plasmatic medium made from the same animal, sealing it in a hanging drop slide, placing it in a thermostat at 37° C., and observing the changes in the tissue by means of a microscope enclosed in a warm chamber kept at the same temperature.

The results of the experiments were uniform. In every case after from one to three days, growth of the specimen was observed. After a period of quiescence, varying according to the nature of the tissue, granulations made their appearance at the margin of the tissue fragment, spindle and polygonal cells were formed and rapidly grew out into the surrounding lymph. The new tissue had many characteristics of the parent material; cartilage produced cartilage; spleen formed cells closely resembling splenic pulp; and, most striking of all, from the surface of bits of kidney grew cell tubules, replicæ of the normal kidney tubes. Once started the growth went on with wild rapidity, the cells branching out in all directions, and the process continuing for days until the nutritive power of the plasmatic medium was exhausted, and then, when once stopped by inanition, immediately becoming reactivated upon reinoculation into fresh plasma. Furthermore, fragments of the newly formed tissue removed from the parent mass and placed in fresh media continued the same active prolific growth as before its separation, the second generation of cells closely resembling the first.

The speed of growth of the tissues varied according to the nature of the material; cartilage began to grow after three days and progressed slowly; peritoneal endothelium and arterial sheath were also slow in starting and sluggish in progress; thyroid and spleen were more active, showing changes in from thirty-six to forty-eight hours; while in the case of kidney, proliferation was seen after twelve hours in the thermostat. Most interesting of all, however, was the behavior of tumor tissue. In their first article the authors report definite growth of a bit of chicken sarcoma after nine hours, and in the second publication a specimen of the same tumor had been seen actively growing two and one half hours after inoculation. Still another specimen of the same tumor, on being measured twenty-four hours after inoculation was found to have increased in size fourteen fold, and after forty-eight hours twenty-two fold, the changes being plainly visible to the naked eye.

It is impossible at the present time to estimate the value of these observations. From the view point of the biologist the production of active manifest life—for where there is cell proliferation and growth there is manifested an active life process—is of infinite academic interest. From the philosophical standpoint a new factor is added to the great problem of life and death. To the mind of the experimental worker in medical science an entirely new field of possibility is thrown open for the study of cancer. Now that it is possible actually to see tumor cells grow and to study directly the various factors which stimulate or retard that growth, it is not extravagant to say that a gigantic stride has been taken toward the discovery of the cause of cancer and the ultimate goal of its prevention and cure.

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A NEW LABYRINTHODONT FROM KANSAS

THE National Museum has recently sent the writer, through the courtesy of Mr. C. W. Gilmore, two specimens which represent a new form of the labyrinthodont amphibia. The specimens comprise a nearly perfect left mandible and a portion of the left side of the face of possibly the same individual. The material comes from "The Coal Measures of Washington County, Kansas." It was among the collections of Dr. Gustav Hambach, now the property of the National Museum.

The stereospondylous amphibia have been suggested in the Carboniferous of North America by several discoveries, notably the two vertebræ described by Marsh as *Eosaurus canadensis* and the tooth from the Coal Measures of Kansas referred by Williston to *Mastodonsaurus*. This is, however, the first actual discovery of any considerable labyrinthodont material from the Carboniferous (? Lower Permian) and as such it is of great interest.

The anatomical characters are so similar to those of *Anaschisma* described by Branson from the Triassic of Wyoming that the species is ascribed without hesitation to the Stereospondylia. The differences between the forms are of generic significance, although the distinctions are not so great as we should expect in forms which are so widely separated stratigraphically. No character in mandible, skull or ribs is primitive. The form will be described and figured soon as a new member of the Labyrinthodontidæ.

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THE UNIVERSITY OF KANSAS,
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SPECIAL ARTICLES

THE SUPPOSED RECENT SUBSIDENCE OF THE MASSACHUSETTS AND NEW JERSEY COASTS

MUCH evidence has been adduced in support of the theory that various portions of the Atlantic coast have been recently undergoing a gradual subsidence, and this movement is believed by many to be still in progress. The rate of subsidence has been calculated as one foot per century for the Massachusetts coast, and from one to two feet per century for the New Jersey coast. Among the lines of evidence which appear to support the theory are the following: Indian shell heaps are found below high-tide level; stumps of trees are found in place in salt marshes, showing that the trees were killed by the invasion of salt water; peat formed by salt-water vegetation is found overlying fresh-water peat; familiar landmarks are covered by high tides to greater depths than formerly; land owners along salt marshes find that the marsh areas have recently encroached upon the upland areas; the tides have increased in height to such an extent that certain tidal mills can no longer be operated as effectively as formerly; dykes erected to keep the tides out of certain salt-marsh meadows are themselves submerged by the rise of the tides; accurate measurements show that a bench-mark established at Boston three quarters of a century ago is now